Application Perspective Case Studies - Hawaiian Species and Habitat Conservation in a shifting climate

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Climate downscaling needs for conservation-driven ecological research in Hawaii:

From the heretic to the mundane

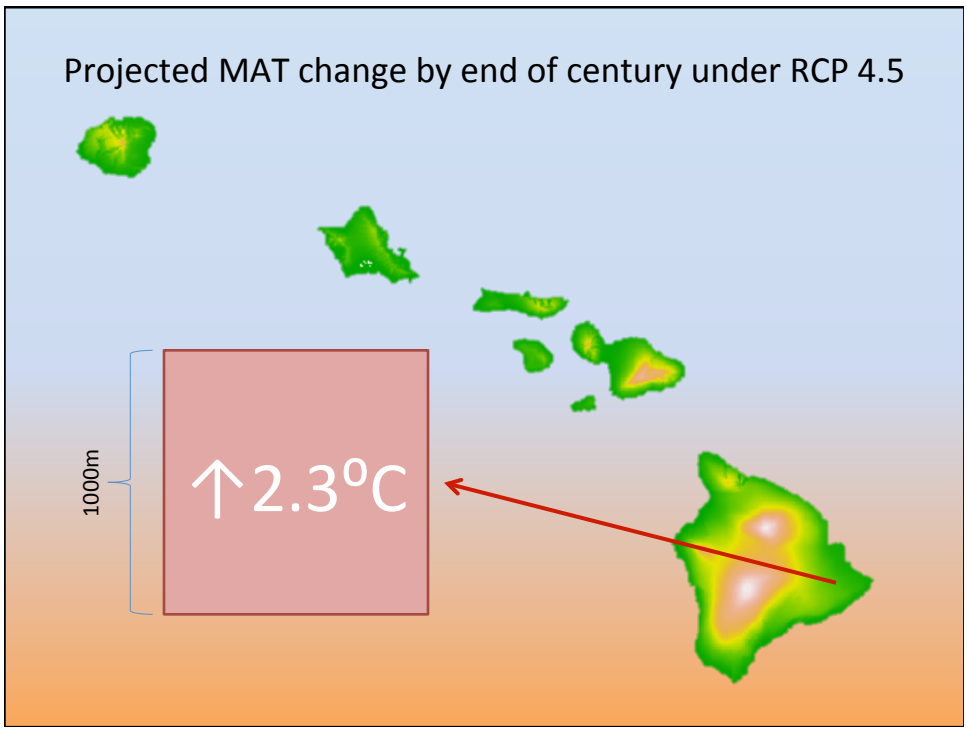
Many applied ecology projects utilizing climate projections

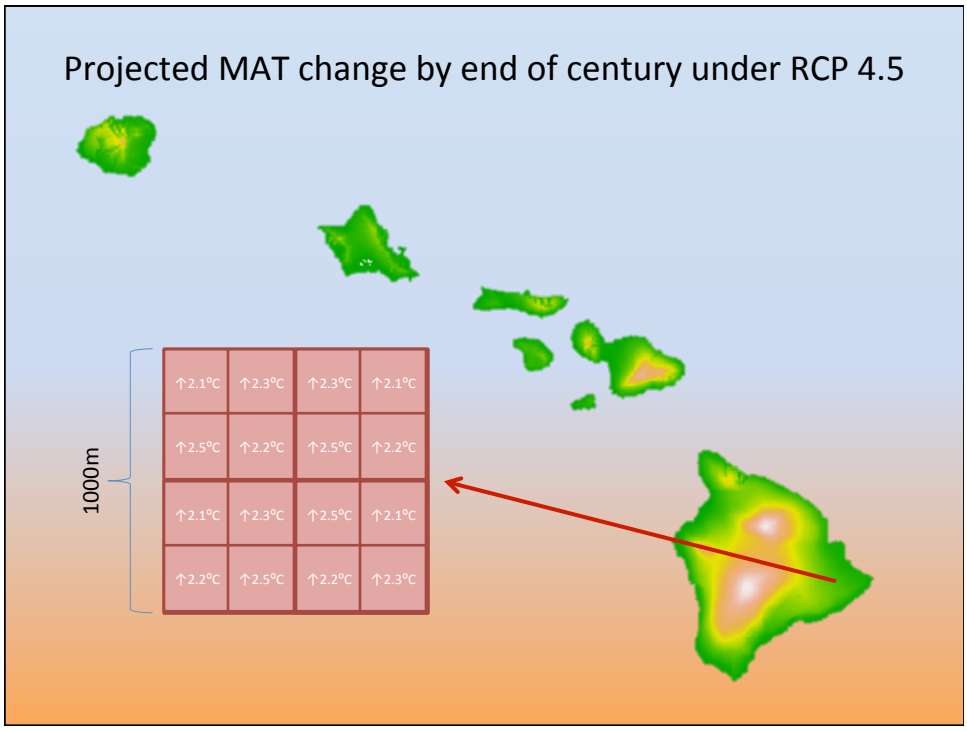
- Vulnerability of native Hawaiian plants to climate change
- Shifts in distribution of Hawaiian forest birds
- Shifts in the suitability of Hawaiian landscape to native biomes
- Invasive species degradation under a changing climate
- Changes in landscape carbon storage and fluxes across Hawaii
- Implications of climatic changes to keystone plant species abundance across Hawaii

Spatial resolution of climate projections

- Very high resolution (<500m) projections does not help much!
- At community scale, local factors and processes determine ecological patterns and processes
- Other unpredictable ecological change vectors make fine scale predictions impossible
- High res projections not useful without a finer understanding of current climate and recent past change

- **Focus on wider scenarios, not higher resolution**


Projected MAT change by end of century under RCP 4.5
1000m
↑2.3°C


Projected MAT change by end of century under RCP 4.5
1000m
↑2.1°C
↑2.3°C
↑2.3°C
↑2.1°C
↑2.5°C
↑2.2°C
↑2.5°C
↑2.2°C
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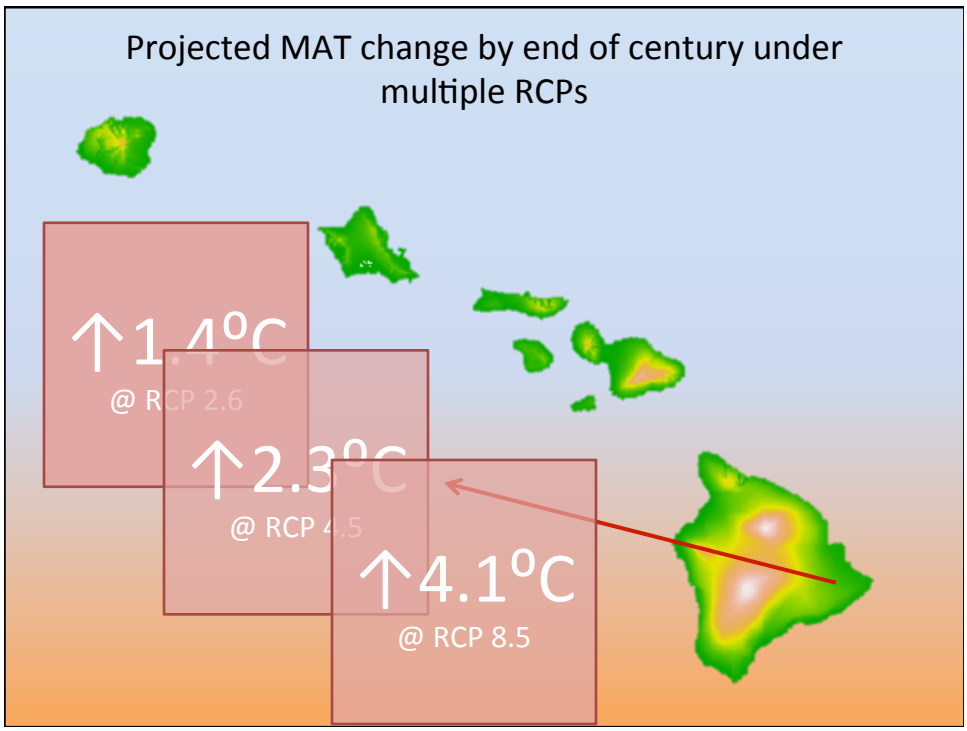


Accurate representation of critical climate features to Hawaii conservation

- Importance features that define ecological boundaries
  - TWI: importance for ecology and conservation
  - Kona wet belt and other similar features
  - El Niño frequency
  - Etc.
- Variables beyond precipitation and temperature that partially drive ecological processes
  - Solar radiation
  - PET
  - Cloud water interception
  - Etc.

Future scenarios

- Single scenario is of limited use
  - Difficult to prevent a 'step change' assumption
- Scenario time periods
  - Two time steps perhaps ideal (mid and late century)
  - Mid-century projections are of greater relevance to decision making
  - Standardized in time intervals for comparison of scenarios

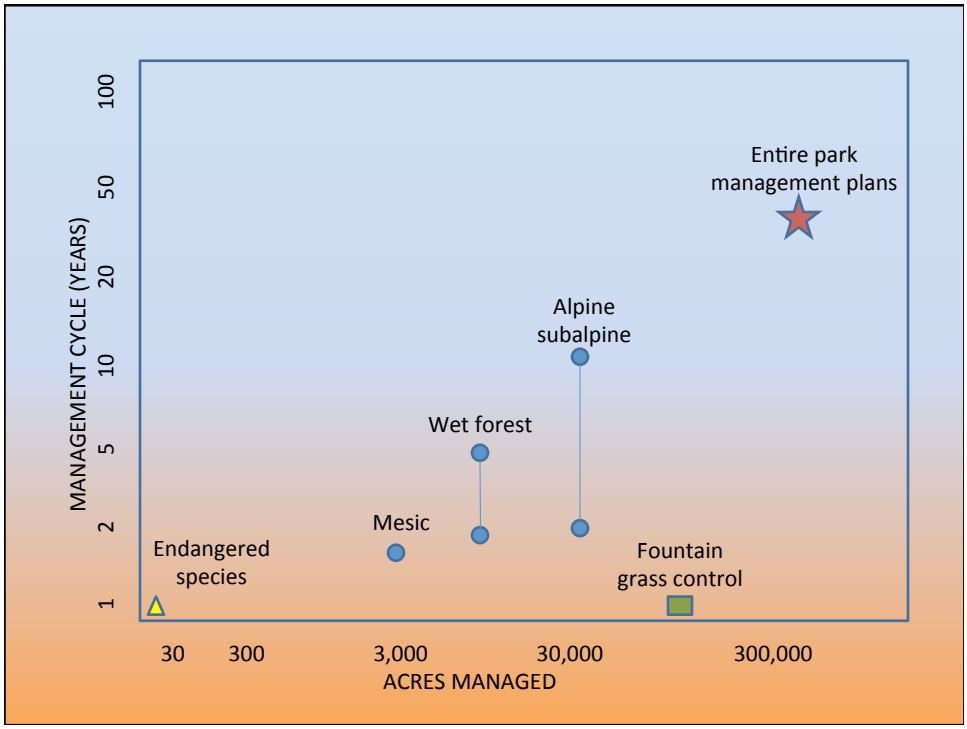
Model validation

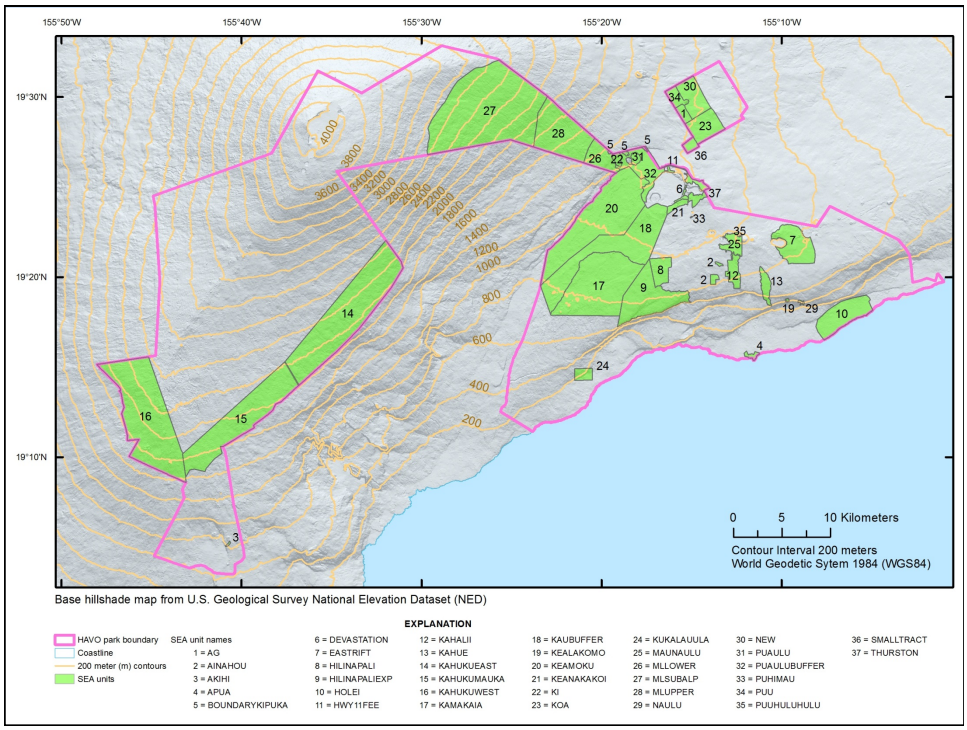
- We do not need to understand how the model was made, but need clear validation metrics
- Clear metrics for model validation for **all variables** based on current observations
- At a minimum, a description of the relative strengths and weaknesses of different projected variables

Data formats

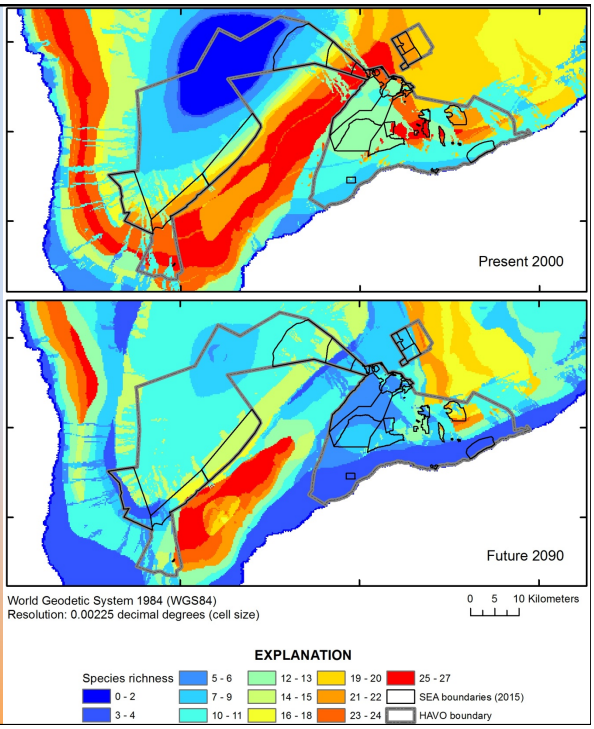
- Temporal resolution: monthly, seasonal, annual averages good for >80% of use
- Raster files, not NCDF
- Files standardized in resolution and extent

Case study: HAVO management in a shifting climate


MANAGEMENT CYCLE (YEARS)
1
2
5
10
20
50
100
Entire park management plans
Alpine subalpine
Wet forest
Mesic
Endangered species
Fountain grass control
30
300
3,000
30,000
300,000
ACRES MANAGED


155°50'W
155°40'W
155°30'W
155°20'W
155°10'W
19°30'N
19°20'N
19°10'N
0 5 10 Kilometers
Contour Interval 200 meters
World Geodetic Sytem 1984 (WGS84)
Base hillshade map from U.S. Geological Survey National Elevation Dataset (NED)
EXPLANATION
HAVO park boundary
Coastline
200 meter (m) contours
SEA units
SEA unit names
1 = AG
2 = AINAHOU
3 = AKIHI
4 = APUA
5 = BOUNDARYKIPUKA
6 = DEVASTATION
7 = EASTRIFT
8 = HILINAPALI
9 = HILINAPALIEXP
10 = HOLEI
11 = HWY11FEE
12 = KAHALII
13 = KAHUE
14 = KAHUKUEAST
15 = KAHUKUMAUKA
16 = KAHUKUWEST
17 = KAMAKAIA
18 = KAUBUFFER
19 = KEALAKOMO
20 = KEAMOKU
21 = KEANAKAKOI
22 = KI
23 = KOA
24 = KUKALAUULA
25 = MAUNAULU
26 = MLLOWER
27 = MLSUBALP
28 = MLUPPER
29 = NAULU
30 = NEW
31 = PUAULU
32 = PUAULUBUFFER
33 = PUHIMAU
34 = PUU
35 = PUUHULUHULU
36 = SMALLTRACT
37 = THURSTON

NATIVE PLANT RICHNESS



Preliminary results: not for public dissemination.

Summary of Lessons Learned

- Interaction and regular feedback with managers is critical throughout the project
- Understand spatial and temporal scale needs of managers
- Link model development and interpretation to thresholds of management actions
- Be realistic about how to address rare species with climate model applications